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Williams et al.

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(54) **MODULAR SMART BIOFEEDING DEVICE**

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(73) Assignee: **In-Pipe Technology Company, Inc.**, Wood Dale, IL (US)

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(51) **Int. Cl.**
C02F 3/00 (2006.01)
B67D 7/84 (2010.01)
(Continued)

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CPC ***C02F 3/00*** (2013.01); ***B01F 13/003*** (2013.01); ***B01F 13/0016*** (2013.01);
(Continued)

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CPC C02F 1/008; C02F 1/685; C02F 1/686; C02F 3/006; C02F 3/348; C02F 2201/007; C02F 2201/008; C02F 2201/009; C02F 2203/006; C02F 2203/008; C02F 2203/36; C02F 2203/44; C02F 2209/005; C02F 2209/008; C02F 2307/08; C02F 3/00; C02F 2201/002; C02F 2201/004; B01F 15/00129; B01F 15/00402; B01F 15/00409; B01F 15/00415; C12M 1/36; C12M 23/44; C12M 23/46; C12M 23/50; C12M 29/00; C12M 41/02; C12M 41/48; B67D 3/00; B67D 3/008; B67D 3/0083; B67D 7/00; B65D 83/00; B65D 88/54; B65D 90/00; B65D 90/12; B65D 90/22; B65D 90/24; B65D 90/50; B65D 90/0053
USPC 210/96.1, 138, 139, 143, 198.1, 199, 210/614, 631, 739; 422/105, 108, 116, 261, 422/268; 137/87.05, 88, 93; 366/150.1, 366/151.1, 152.1, 182.1; 239/52, 145.1, 239/160, 173, 180, 185.1, 325, 372, 373
See application file for complete search history.

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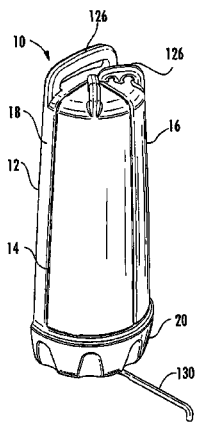
Primary Examiner — Joseph Drodge
(74) *Attorney, Agent, or Firm* — McHale & Slavin, P.A.

(57) **ABSTRACT**

The instant invention describes a device and system for dispensing microbial solutions into a wastewater treatment environment. The device contains one or more removable modules that provides the user with the capability of quickly and easily removing one or more of the modules without the need for replacing or removing the entire unit. The modules are preferably designed to hold bags filled with a microbial solution. The bags are fluidly connected to a pump which dispenses the solution to a predetermined location.

24 Claims, 12 Drawing Sheets



(51) **Int. Cl.**

B01F 15/00	(2006.01)
B01F 13/00	(2006.01)
B67D 3/00	(2006.01)
C02F 3/34	(2006.01)
C02F 1/68	(2006.01)

(52) **U.S. Cl.**

CPC ***B01F 15/00662*** (2013.01); ***B67D 3/008*** (2013.01); ***B67D 7/84*** (2013.01); ***C02F 3/348*** (2013.01); *C02F 1/686* (2013.01); *C02F 2201/007* (2013.01); *C02F 2201/009* (2013.01); *C02F 2209/008* (2013.01); *C02F 2307/08* (2013.01); *Y02W 10/37* (2015.05)

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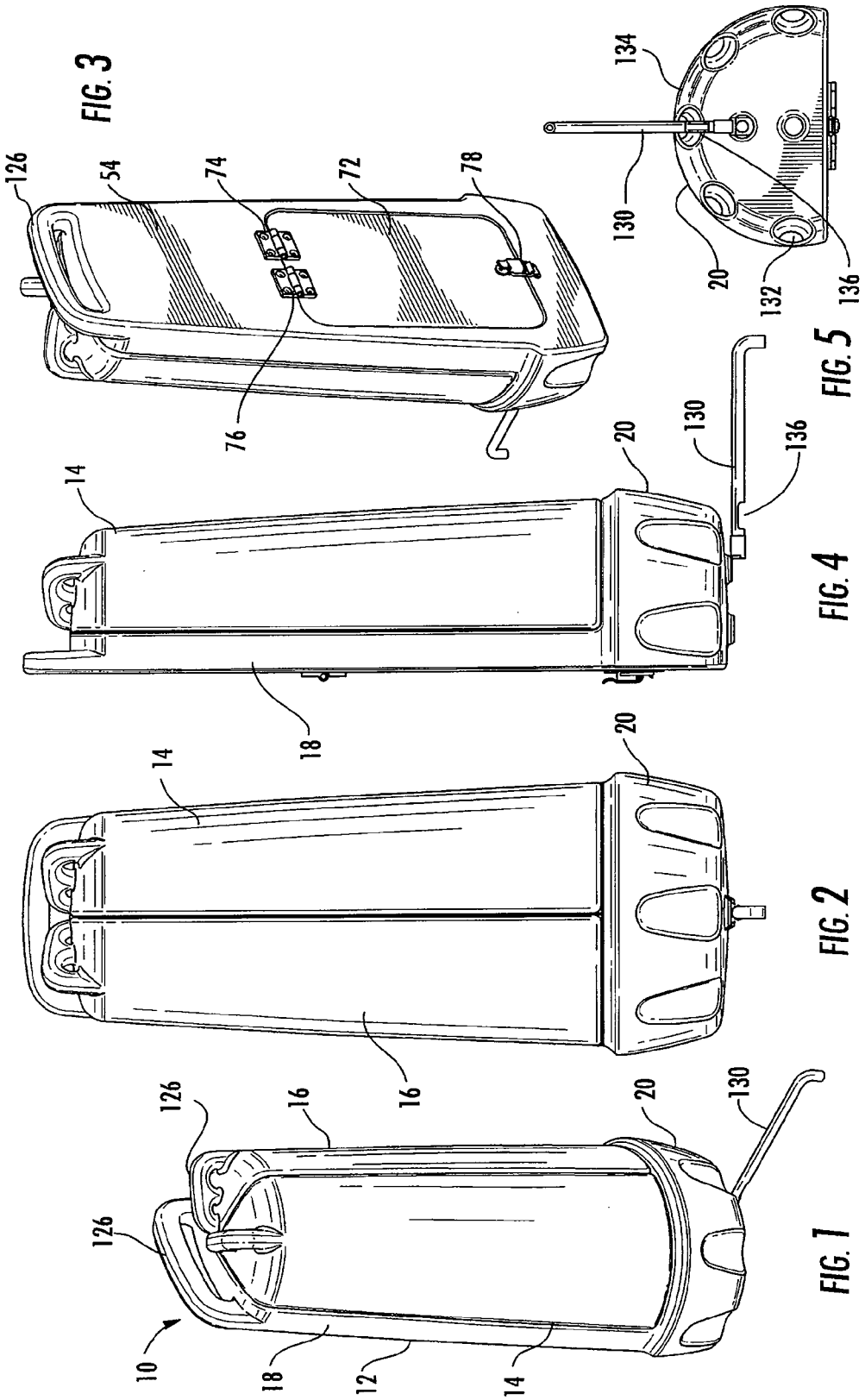
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FIG. 1
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FIG. 5

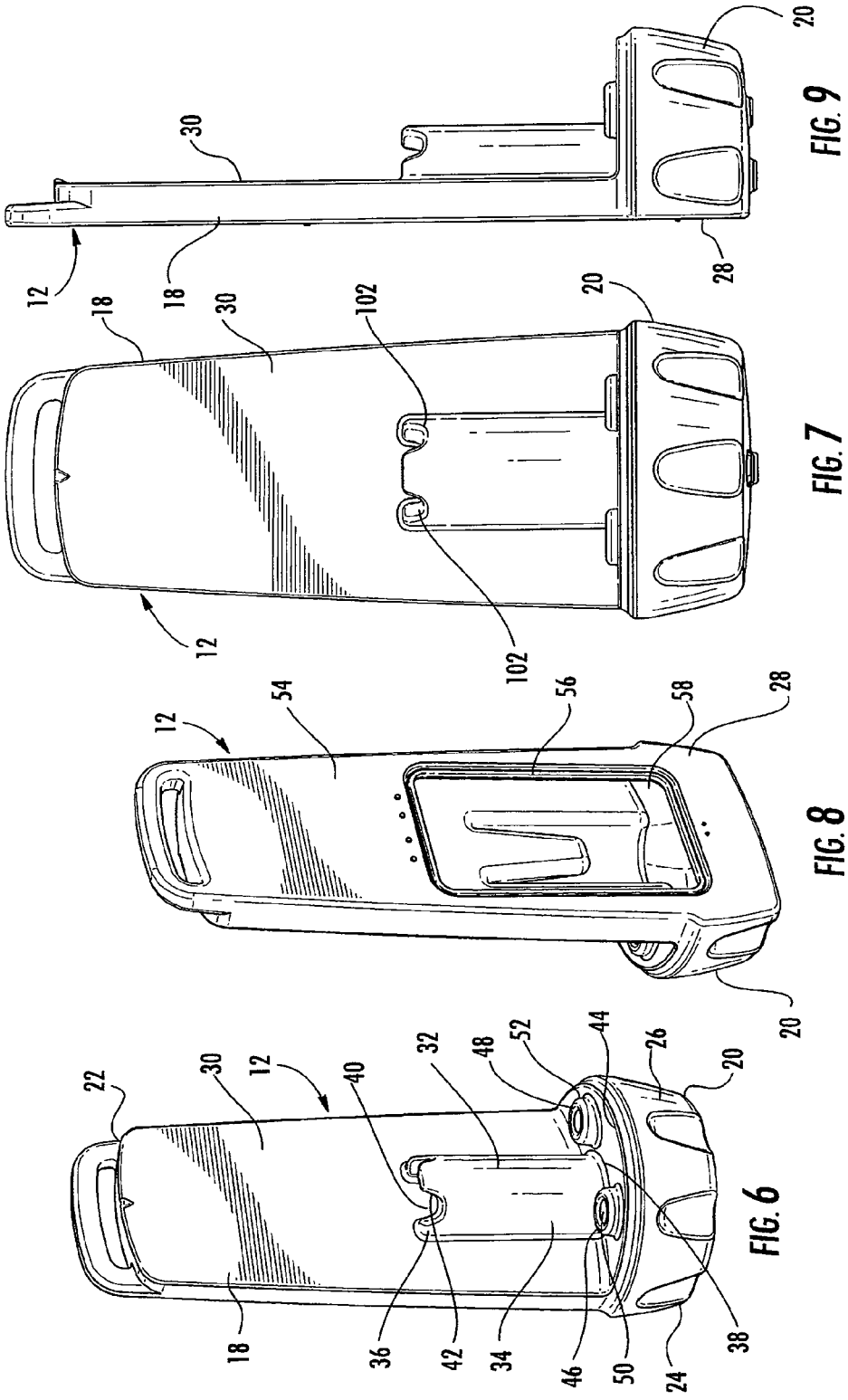


FIG. 6

FIG. 8

FIG. 7

FIG. 9

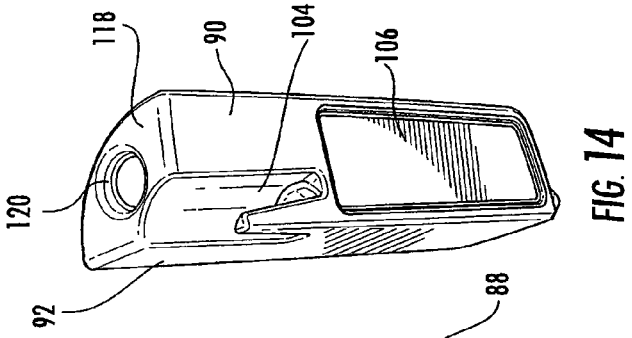


FIG. 14

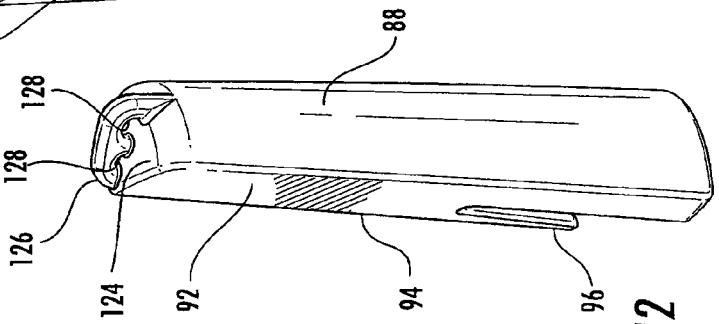
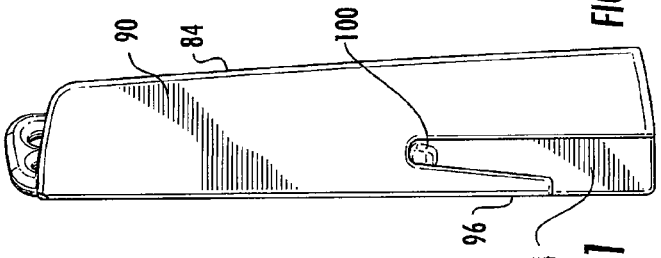


FIG. 13

FIG. 12



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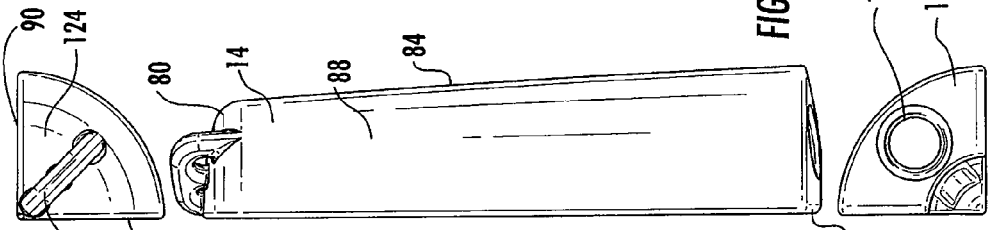


FIG. 15

FIG. 16

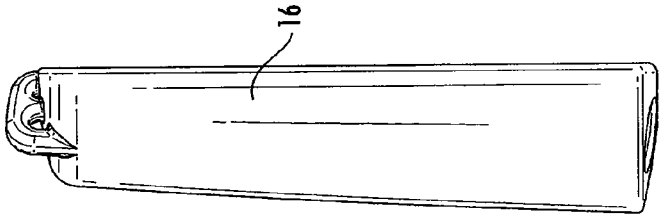


FIG. 10

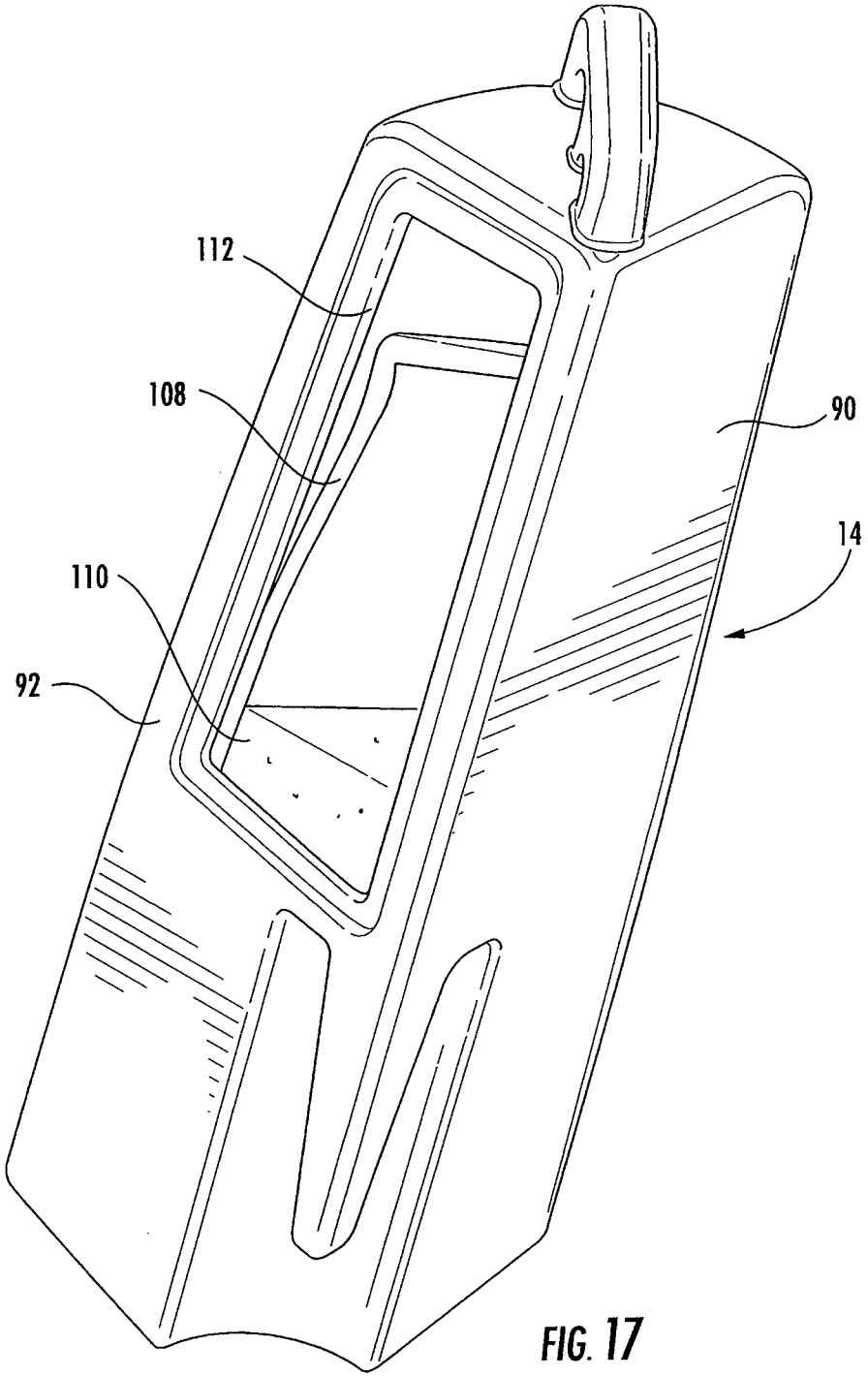


FIG. 17

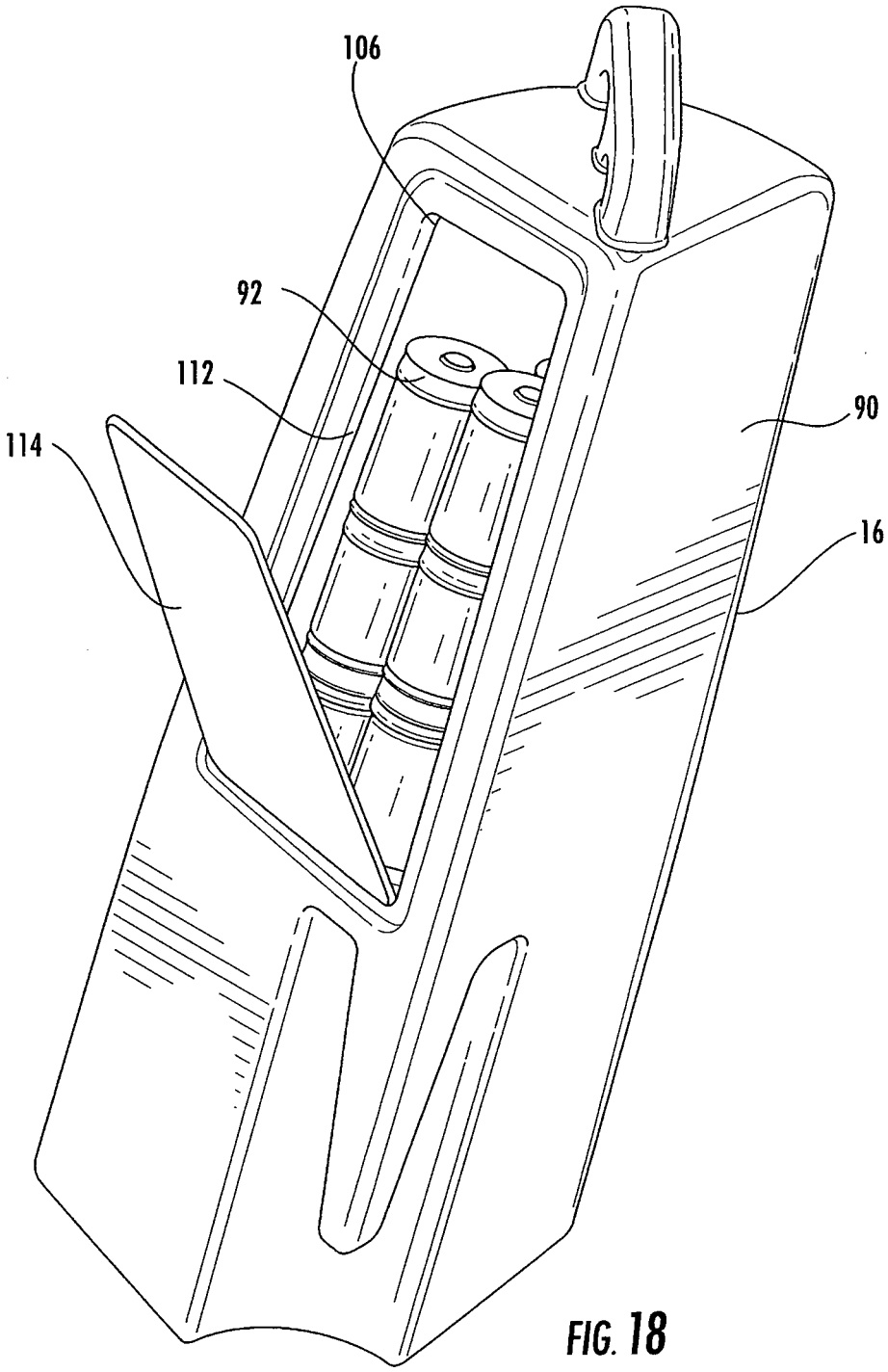
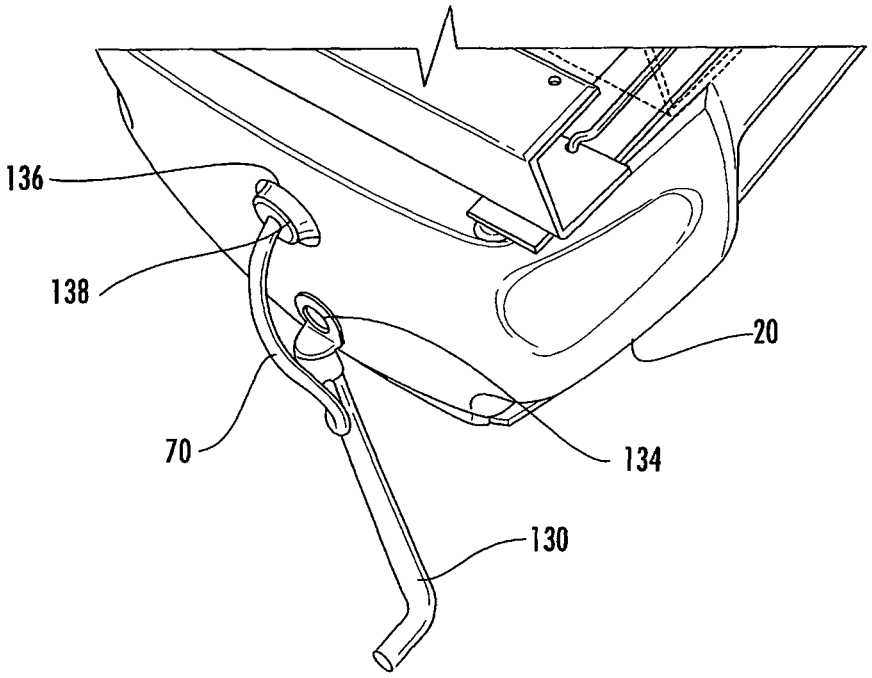


FIG. 18



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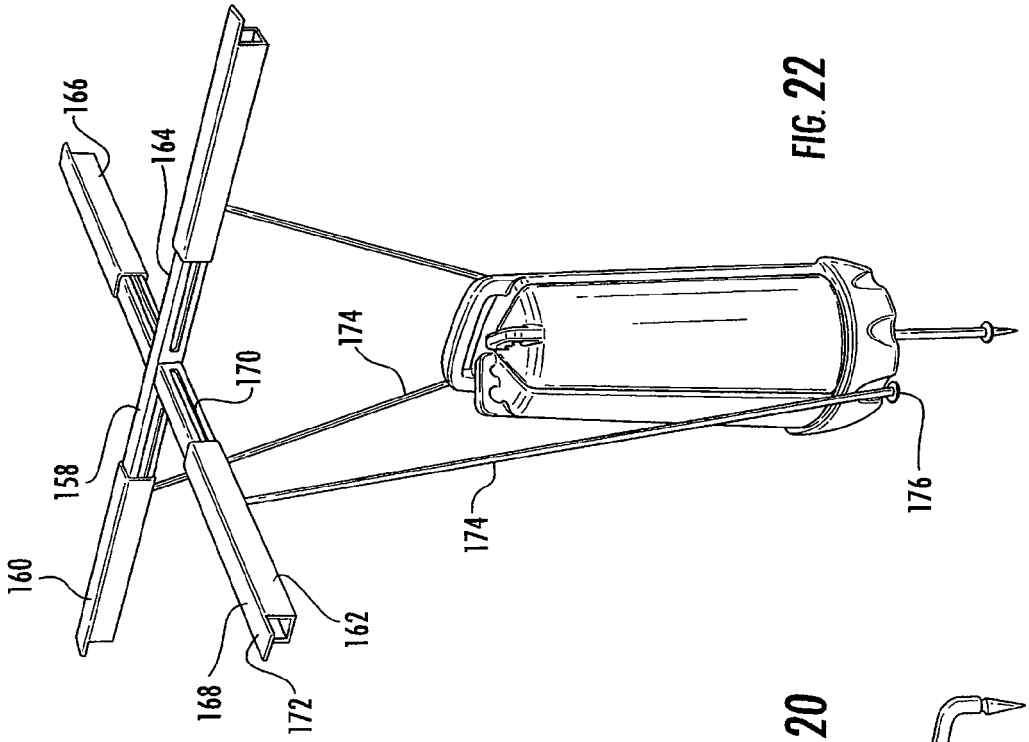


FIG. 22

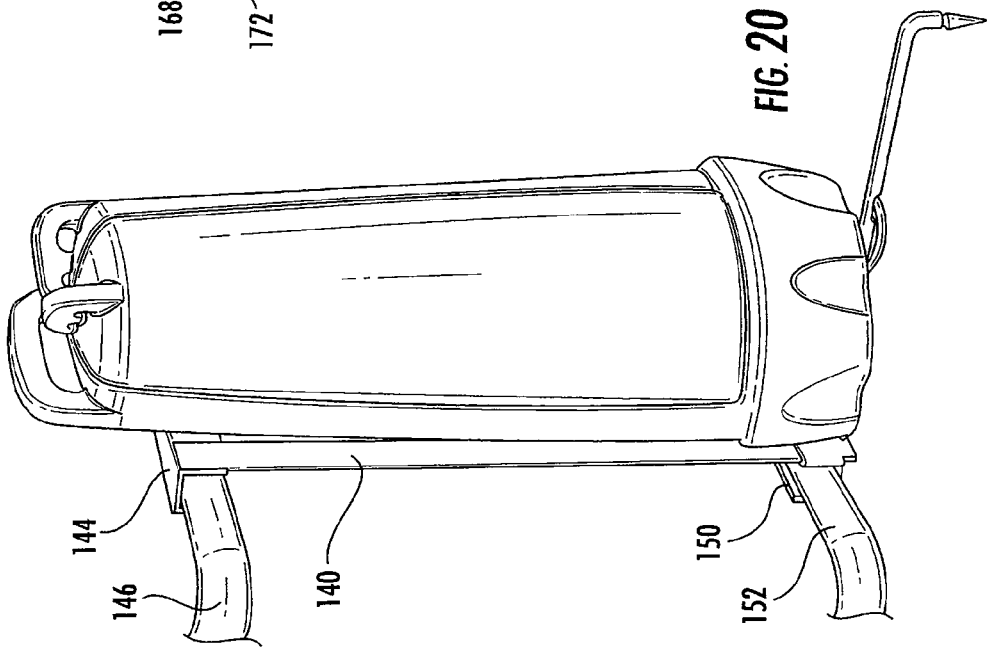
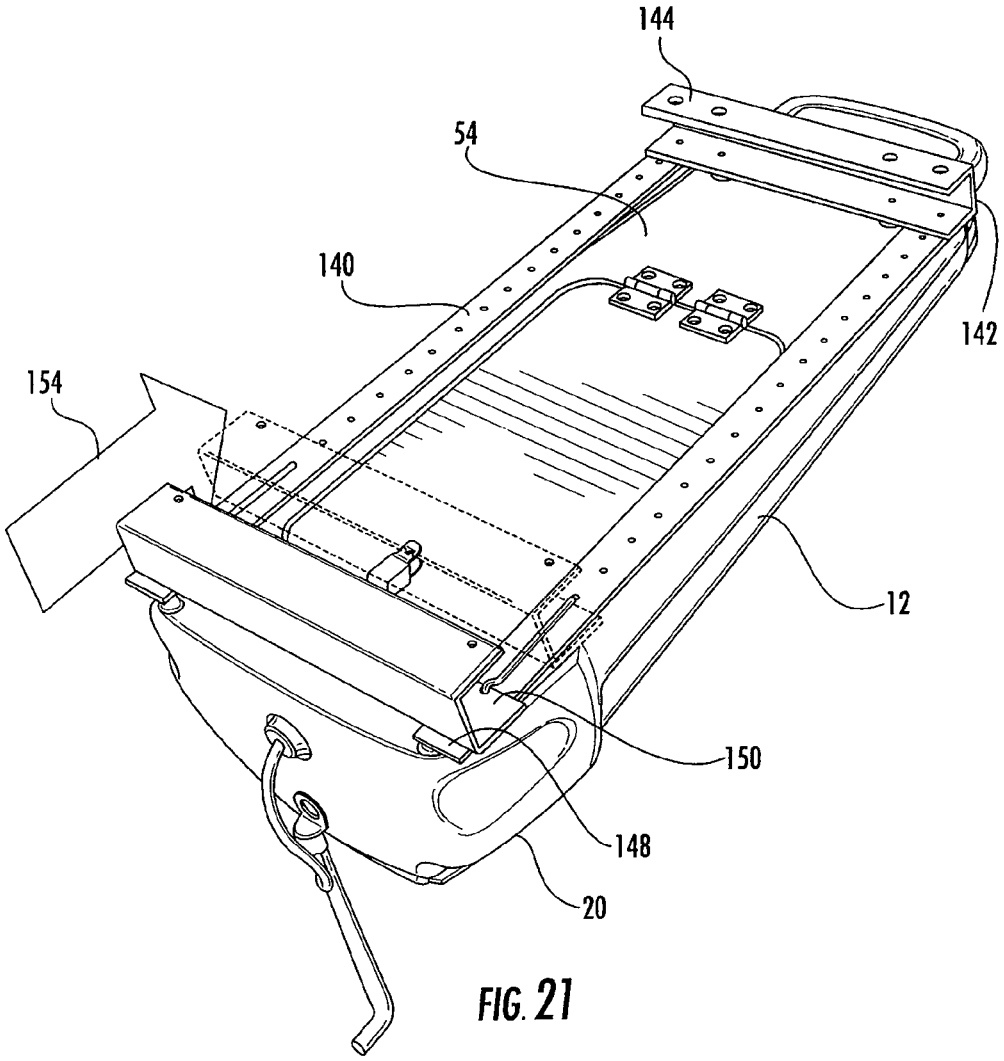


FIG. 20



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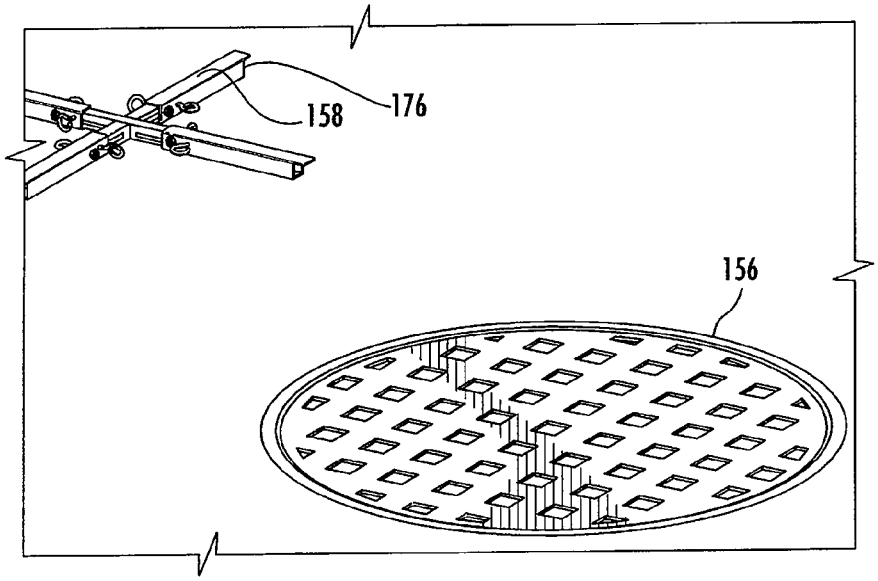

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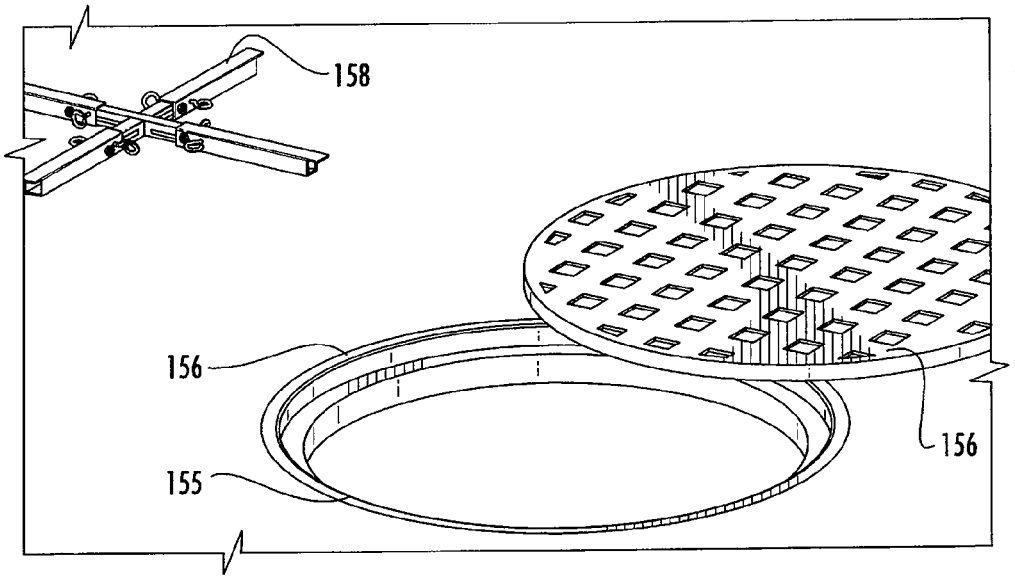

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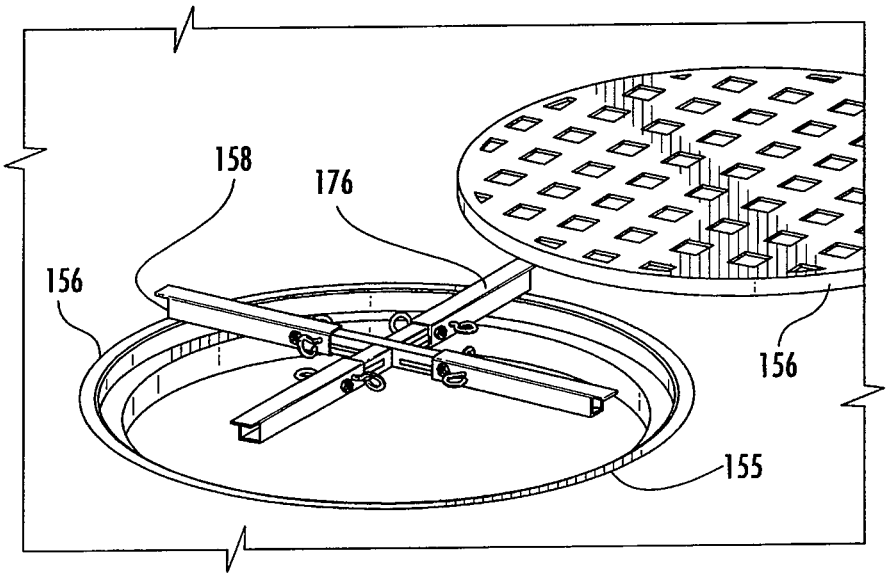

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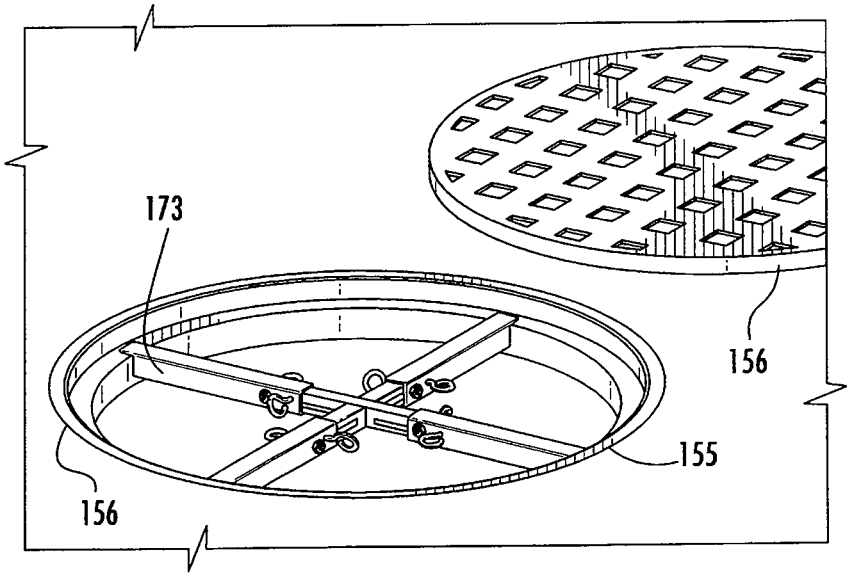
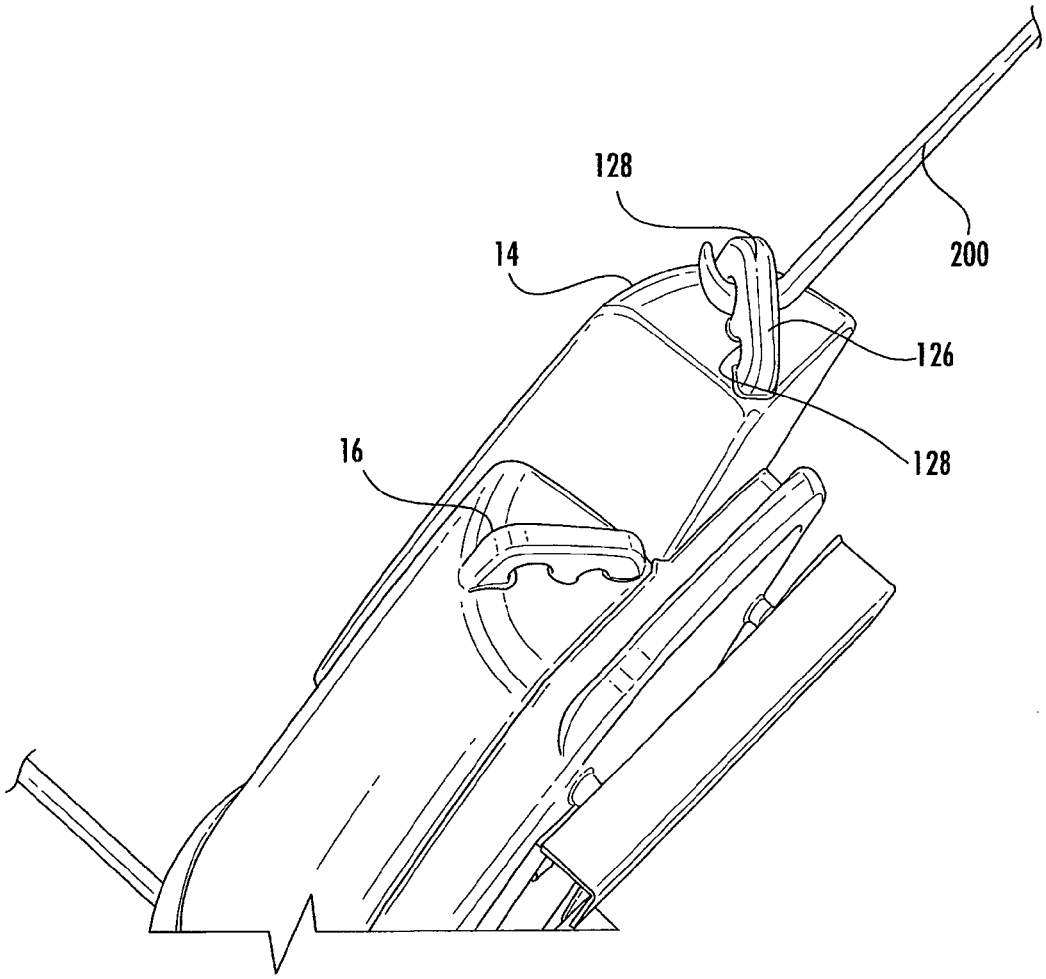


FIG. 26



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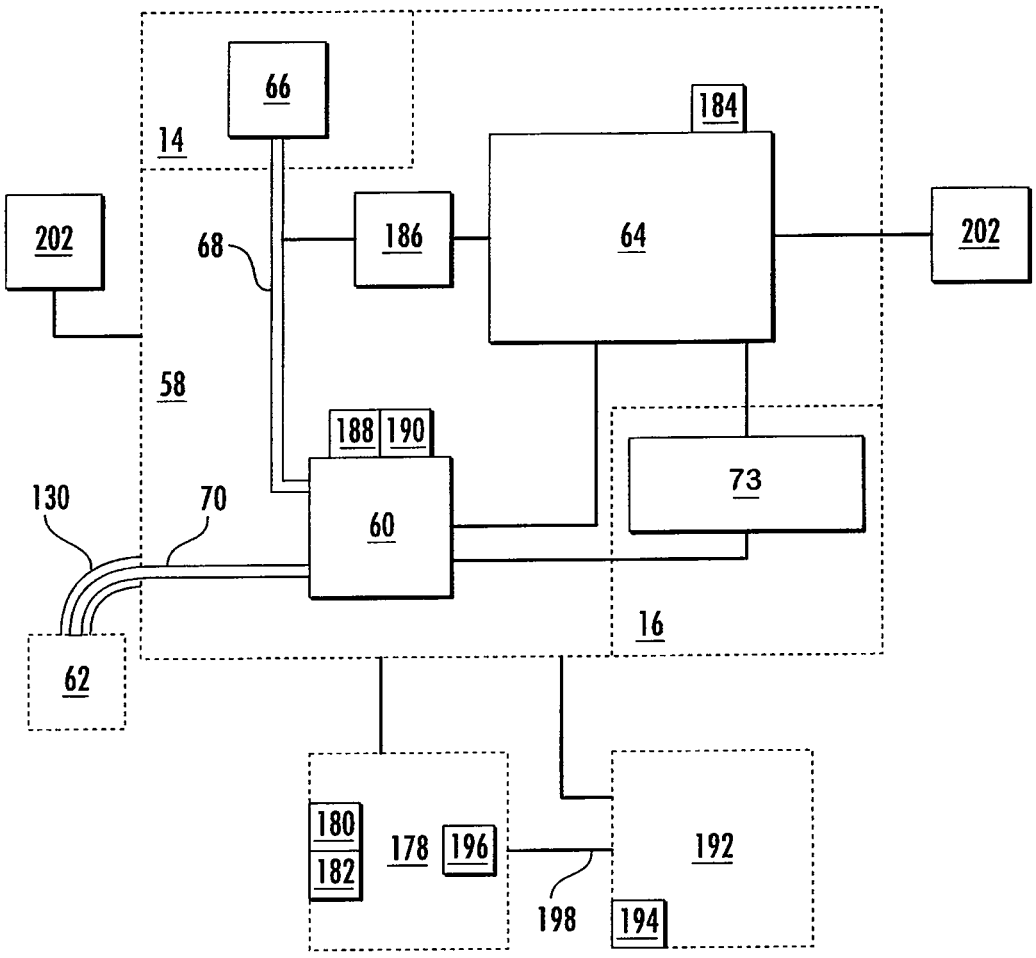
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FIG. 28

MODULAR SMART BIOFEEDING DEVICE

PRIORITY CLAIM

In accordance with 37 C.F.R. 1.76, a claim of priority is included in an Application Data Sheet filed concurrently herewith. Accordingly, the present invention claims priority under 35 U.S.C. §119(e), 120, 121, and/or 365(c) to U.S. Provisional Application No. 61/585,288, entitled "A Modular Smart Biofeeding Device", filed Jan. 11, 2012. The contents of which the above referenced application is incorporated herein by reference.

FIELD OF THE INVENTION

This invention relates to wastewater treatment; and more particularly to a modular device and system for dispensing biological materials within a wastewater system environment.

BACKGROUND OF THE INVENTION

Removal and treatment of wastewater is a major task for local governments. In the early 20th century, municipalities began to adopt biological methods that now form the basis by which wastewater treatment plants function. Microorganisms act to catalyze the oxidation of biodegradable organics and other contaminants generating innocuous by-products such as carbon dioxide, water and biomass (sludge). In these systems, bacteria grow and divide, producing biosolids and clean water effluent. Today, this metabolism occurs in wastewater treatment plants which have the limits of size, retention time, processing capacity, and municipal budgets.

Technology exists, such as that described in U.S. Pat. Nos. 5,578,211 and 5,788,841 and commercialized by In-Pipe Technology Company, Inc. (Wheaton, Ill.) to effectively enhance the fundamental wastewater treatment process by starting treatment at strategic locations throughout the sewer collection system. Miles of sewer pipe are transferred into an active part of the wastewater treatment process, optimizing the entire infrastructure. This improves operating economics without additional capital expenditure. Since it uses natural, biological methods that work with the treatment plant's own processes, such technology is an environmentally and economically sound sustainable solution. However, maintaining bacteria concentrations at proper levels is a significant cost associated with systems employing the '211 and '841 patents.

Thus, what is needed in the art is a device that dispenses biological solutions into a wastewater treatment environment which reduces overall costs associated with delivery of the microbial agents into the system.

SUMMARY OF THE INVENTION

The instant invention describes a device and system for dispensing biological solutions into a wastewater treatment system containing a biological dispensing unit located within the wastewater environment, such as a sewer system, remote programming devices, and a main control device located remotely from the dispensing unit. The dispensing unit device contains one or more removable modules that provide the user with the capability of quickly and easily removing biological solutions stored within, without the need for replacing or removing the entire unit. The modules are preferably designed to hold bags filled with biological, i.e. microbial, solutions. The bags are fluidly connected to at least one material delivery unit which includes a pump to dispense the solution to a predetermined location through one or more tubing.

Accordingly, it is a primary objective of the instant invention to provide a modular smart device and system for dispensing biological solutions into a wastewater treatment environment.

It is a further objective of the instant invention to provide a system using a modular smart device for dispensing biological solutions into a wastewater treatment environment.

It is yet another objective of the instant invention to provide a modular smart biofeeder device and system which can be controlled remotely.

It is a still further objective of the instant invention to provide a modular smart biofeeder device and system which operates with wireless technology.

It is a further objective of the instant invention to provide a modular smart biofeeder device and system which minimizes costs associated with supplying a bacterial solution to a particular environment.

Other objectives and advantages of this invention will become apparent from the following description taken in conjunction with any accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention. Any drawings contained herein constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE FIGURES

FIG. **1** is a perspective view of an illustrative embodiment of the modular smart biofeeder device in accordance with the instant invention;

FIG. **2** is a front perspective view of the modular smart biofeeder device in accordance with the instant invention;

FIG. **3** is a rear perspective view of the modular smart biofeeder device in accordance with the instant invention;

FIG. **4** is a side perspective view of the modular smart biofeeder device in accordance with the instant invention;

FIG. **5** is a bottom view of the modular smart biofeeder device in accordance with the instant invention;

FIG. **6** is a perspective view of the main unit of the modular smart biofeeder device illustrated in FIG. **1** with the modules removed;

FIG. **7** is a front perspective view of the main unit of the modular smart biofeeder device with the modules removed;

FIG. **8** is a rear perspective view of the main unit of the modular smart biofeeder device with the modules removed;

FIG. **9** is a side perspective view of the main unit of the modular smart biofeeder device with the modules removed;

FIG. **10** is a front perspective view of a module;

FIG. **11** is a perspective view of the second module;

FIG. **12** is a left side perspective view of the second module shown in FIG. **11**;

FIG. **13** is a right side perspective view of the second module shown in FIG. **11**;

FIG. **14** is a bottom perspective view of the second module shown in FIG. **11**;

FIG. **15** is a top view of the second module shown in FIG. **11**;

FIG. **16** is a bottom view of the second module shown in FIG. **11**;

FIG. **17** is a perspective view of the module with a biosolution bag stored within;

FIG. **18** is a perspective view of the module with a plurality of batteries stored within;

FIG. **19** is a partial view of the bottom of the base, illustrating the attachment of a dispensing bar;

FIG. **20** is a front perspective view of the biofeeder device with an illustrative embodiment of an attachment structure;

FIG. **21** is a rear perspective view of an attachment structure shown in FIG. **20**;

FIG. **22** is a perspective view of the biofeeder device with an alternative embodiment of the attachment structure;

FIG. **23** illustrates the attachment structure shown in FIG. **22** prior to attachment to a manhole;

FIG. **24** illustrates the attachment structure shown in FIG. **23** being extended, just prior to attachment to the manhole;

FIG. **25** illustrates the extended attachment structure shown in FIG. **24** being placed over the manhole;

FIG. **26** illustrates the attachment structure shown in FIG. **25** being attached to the manhole;

FIG. **27** illustrates removal of one of the modules; and

FIG. **28** is a block diagram illustrating the components of the system in accordance with the instant invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. **1-5**, in which similar reference characters denote similar elements throughout the several views, an illustrative example of a modular smart biofeeder device **10** is illustrated. The biofeeder device **10** comprises a main dispensing unit **12** and one or more removable modules **14** and **16**. While the biofeeder device **10** is described as having two removable modules, additional modules may be utilized as well. The main dispensing unit **12** comprises a vertical support structure **18** and a base **20**. The support structure **18** and the base **20** are preferably integrally constructed as a single unit, but may be constructed as individual units connected or secured together using techniques known in the art. The one or more removable modules **14** and **16** are constructed and arranged to be securable to the support structure **18** and the base **20**. Each module is preferably made of a durable plastic material.

Referring to FIGS. **6-9**, the biofeeder device **10** is illustrated with the removable modules **14** and **16** detached from the main dispensing unit **12**. The support structure **18** is shown having a generally rectangular shape; however, such shape is not intended to be limiting as the support structure **18** can take on other shapes without departing from the spirit of the invention. The top end **22** of the support structure **18** forms the top end of the main dispensing unit **12**. The base **20**, which is attached to the bottom of the support structure **18**, forms the bottom end **24** of the main dispensing unit **12**. The base **20** contains a partially cylindrical portion **26** and a planer portion **28**, see FIGS. **8** and **9**. The interior surface **30** of the support structure **18** is generally planer and allows for a portion of the modules **14** and **16** to abut and rest flush with the support structure **18**. The interior surface **30** contains a first module securing member **32**, illustrated herein as a partially cylindrical structure **34**. The partially cylindrical structure **34** contains a first end **36** and a second end **38**. The first end **36** contains opening **40** which exposes an interior cavity **42** therein. The second end **38** is closed and rests on the upper surface **44** of the base **20** at or near where the support structure **18** intersects with the base portion **20**. The length and width of the partially cylindrical structure **34** is preferably sized and shaped to accommodate a portion of the removable module **14** or **16** to prevent lateral, or side-to-side, movement of the modules away from or off the main unit **12**.

Positioned on the upper surface **44** of the base **20** is a second module securing member, illustrated herein as cylindrically shaped plug members **46** and **48**. Each of the plug members **46** and **48** is constructed and arranged to provide secured mating with a portion of the removable modules **14** and **16**. The plug members **46** and **48** may be solid, or alternatively may contain an opening **50** which exposes an internal cavity. The plug members **46** and **48** may contain a rimmed or lipped outer surface **52** to provide a friction or snap fit connection to secure the removable module **14** or **16** to the base **20**, thereby preventing both lateral movement and horizontal movement. The rimmed or lipped outer surface **52** is constructed and arranged to prevent the modules from upward and/or side-to-side movement while allowing the modules to be detached under a sufficient predetermined force.

The back surface **54** of the main dispensing unit **12** contains opening **56** which exposes an interior compartment **58**. The interior compartment **58** is constructed and arranged to hold a variety of hardware to provide the device with fluid dispensing functionality. FIG. **28** is a diagrammatic representation of the system in accordance with the instant invention showing several components of a preferred embodiment of the hardware contained within the interior compartment **58**. A pump **60** for dispensing microbial solutions to a wastewater environment **62** is controlled and operated by a control unit, such as a microcomputer **64** or printed circuit board. The control unit is constructed and arranged to operatively control the functioning of the device. For example, the control unit can be programmed to deliver predetermined concentrations of a biological solution at a predetermined rate. Additionally, the control unit may contain or be coupled to a programmable clock for dispensing of the type of bacterial solution and or concentrations based on predetermined factors including, but not limited to, time of year, month, or week, diurnal cycles, or seasonal changes. The control unit may also be adapted to dispense microbial loads based on the type of wastewater generated in the wastewater system. The pump **60** is fluidly connected to a solution supply **66** located outside of the interior compartment **58** (preferably within the removable module **14** through a tubing **68** and dispensed to the wastewater environment **62** through a second tubing **70**. The microcomputer **64** and the pump **60** are powered by a power source **73**. Preferably, the power source is located outside of the interior compartment **58**, such as but not limited to, within the module **16**. In this configuration, the device utilizes independent compartments which can be removed and replaced without the need for disrupting other components of the device, such as the other module **14**. Each of the components located in the interior compartment **58** is accessible through a door panel **72**, see FIG. **3**. The door panel is hingedly connected to the back surface **54** through hinges **74** and **76** to allow the user easy and quick access to the interior compartment **58**. Maintaining the door panel **72** in a closed position protects the internal components from the external environment. The door panel **72** may be secured to the base portion **20** through a securing member **78**, such as a locking clasp or other securing means known to one of skill in the art.

Referring to FIGS. **10-16**, the removable modules **14** and **16** are shown. Both of the removable modules **14** and **16** are preferably constructed and arranged in the same way. Accordingly, only the removable module **14** is described in detail. However, each of the elements described for removable module **14** is applicable to the removable module **16**. The removable module **14** contains a first end **80**, a second end **82**, and a main body **84** extending there between, see FIG. **11**. The front surface **88** is partially rounded and arranged to face away from the interior surface **30** of the main dispensing unit **12**. Two generally planar interior surfaces **90** and **92**, see FIGS. **12** and **15**, converge along the longitudinal axis **94** (FIG. **13**) to form the module's back surface. Surface **90** is

constructed and arranged to align with or contact a portion of the interior surface **30** of the main dispensing unit **12**. Surface **92** is constructed and arranged to align with and/or contact a corresponding interior surface of the adjacent removable module **16**. Preferably aligned with or extending from the longitudinal axis **94** is a finger-like protrusion **96** constructed and arranged to be coupleable to the first removable module securing member **32**. To secure the removable module **14** to the main dispensing unit **12**, the finger-like extension **96** is inserted into the opening **40** of the first end **36** of the cylindrical structure **34** and into the interior cavity **42**. The curved portion **100** of the removable module **14**, see FIG. **12**, is designed to align with the curvature **102** (FIG. **7**) along the first end **36** of the cylindrical structure **34**. The length and width of the partially cylindrical structure **34** is preferably sized and shaped to accommodate a portion of the removable module **14** or **16** to prevent lateral movement away from or off the main unit **12**. Once inserted within, all or a portion of the first removable module securing member **32** is located within a cut out portion **104** (FIG. **14**) positioned within the back surface of the removable module **14**.

The main body **84** of the removable module **14** contains at least one internal compartment **106**, see FIG. **14** or FIG. **17**, which is constructed and arranged to hold one or more objects. Preferably, the internal compartment **106** contains a bag **108**, similar to a plastic medical style intravenous bag, which contains a solution **110**, such as a microbial solution of one or more bacteria species, to be dispensed, see FIG. **17**. The at least one internal compartment **106** may contain a window, made of glass, or clear plastic, positioned on the internal surface **90** or **92** to provide visualization of the contents within. Alternatively, no window or viewing mechanisms is provided. While the preferred embodiment includes the use of a bio-solution bag, the solution **110** may be directly placed within the internal compartment **106** without the use of a bag. The bag **108** may be inserted or removed through the use of a panel door (not shown) or through the use of a removable top or bottom portion (not shown) so that the user can unscrew or pop off the top to place the bio-solution bag **108** within the interior.

FIG. **18** illustrates the removable module **16** containing a power source. The power source, illustrated herein as a plurality of batteries **112**, is stored within the internal compartment **106**. The removable module may be constructed such that the power source is rechargeable, whereby plugging the unit into an electrical outlet may recharge the batteries or provide the necessary power to run the unit. Moreover, attaching the module **16** to the base unit **20** provides electrical connection to power one or all of the hardware. Alternatively, the batteries **112** may be disposable batteries. A hinged panel **114** secures the batteries within the internal compartment **106** and provides a mechanism for easy access.

Referring to FIGS. **14** and **16**, the bottom surface **118** of the removable module **14** contains a module securing member receiving element **120**. The module securing member receiving element **120**, illustrated herein as a circular receptacle containing an opening **122** is sized and shaped to receive plug members **46** or **48**. The module securing member receiving element **120** may be stepped to provide a better securing means.

Referring to FIGS. **13** and **15**, the top surface **124** of the removable module **14** contains a retrieving or gripping member, illustrated herein as a handle **126**. The retrieving member may contain one or more openings **128** to allow a device to be inserted within and secured there to. In addition to the retrieving member **126** of the removable modules **14** or **16**, the main dispensing unit **12** also contains a retrieving or griping member, or handle **126** placed at the upper end, see FIG. **1**, to allow for handling and placement of the biofeeder **10** to an area.

Referring back to FIGS. **5** and **19**, the base **20** contains a dispensing bar **130** attached to the surface **132** through a securing means, such as but not limited to a screw **134**. The dispensing bar **130** is sized and shaped to receive and hold the dispensing tube or drip line **70** which is fluidly connected to the pump **60**. A cut out portion **136** allows the dispensing tube **70**, which is extendable through the cut out portion **136**, see FIG. **19**, to be placed within the dispensing bar **130**. The opening **136** preferably contains a mechanism to prevent liquids from entering or exiting, such as a stopper **138**, a membrane (not illustrated), or other means known to one of skill in the art.

By providing individual modules **14** or **16**, the biofeeder device **10** is designed to be placed within a particular environment and remain in place over an extended period of time. When the contents of the modules have been depleted, the user retrieves the module from the main unit **12**, removes its content, and replaces it with new materials. The module is then secured to the main unit **12**. This is accomplished without the need to remove the entire device **10**. As an illustrated example, the biofeeder **10** is placed in a wastewater environment, such as a sewer pipe where its primary function is to dispense fluid, i.e. a biological solution, preferably a bacteria solution having one or more strains of bacteria, to the pipes, thereby providing a bacteria flora that helps increase the efficiency of the wastewater treatment plant and extend the life of existing infrastructure. The biofeeder **10** is designed to attach to existing structures within any environment. In the sewer pipes, the biofeeder device **10** may contain a securing bracket **140**, see FIGS. **20** and **21**, attached to the back surface **54** of the main dispensing unit **12**.

The bracket **140** contains a first end **142** constructed and arranged to contain a first mechanism **144**, illustrated as a generally u-shaped member, for attaching or hooking onto an existing structure within the environment, such as but not limited to a ladder rung **146**. Such ladder rungs are typically located within sewers and are used to provide city workers a means of accessing the sewer system. A second end **148** contains a second mechanism **150**, illustrated as a generally u-shaped member (the u-shape formed in the opposite direction as the first mechanism **144**) for attaching or hooking onto adjacent or other ladder rungs **152**. The second mechanism **150** is preferably spring loaded so that it may move in an upward direction, see arrow **154**, or downward direction depending on the distance between adjacent ladder rungs in order to connect to ladder rungs that are not uniformly spaced apart.

Alternatively, the biofeeder **10** may be secured to the opening **155** of a sewer system manhole **156**, see FIGS. **22-26**. A crossbar **158** is placed into position so that each of the bars **160**, **162**, **164**, and **166** rests within the manhole **156**. Each of the bars contain an extender bar **168** which is slidably movable within a channel **170** in order to extend the length of each bar to fit variously sized manholes. An overhang portion **172** located at the end of the extender bar **168** rests on the surface **173** of the manhole **156** to provide secure attachment. One or more securing members, illustrated herein as cables **174**, are attached to one or more portions of the crossbar **158** at one end and to one or more portions of the biofeeder device **10** at a second end. The cable **174** may be attachable to the biofeeder **10** through the handles **126** or O-rings, hooks, or eyelets **176** positioned at various places on the biofeeder **10** and/or crossbar **158**. In this manner, the biofeeder device **10** is secured to the manhole **156** and hangs down into the sewer system.

Regardless of the mechanism of attachment to the sewer system, the biofeeder device **10** functions primarily to dispense predetermined amounts of the bacteria solution into a precise location within the sewer pipe at predetermined times. The bacteria solution **110** placed in the bag **108** and stored in the removable module **14** is fluidly connected to the pump **60** through tubing **68**, see FIG. **28**, and dispersed out using the tubing **70**. The pump **60** is controlled by the on board microcomputer **64** which may also include an AVR microcontroller from Atmel Corporation. The solution **110** is preferably dispensed at a designated rate and at designated times. For example, the biofeeder device **10** may operate on diurnal cycles, having circuitry and a time clock to deliver various amounts of the microbe solution based on pre-determined factors, such as historical loads, time frames when wastewater generation is high/low, time periods within a 24 hour period, or seasonal time periods. Dispensing of the solution **110** can be programmed on board or remotely using a remote unit **178** having a receiver **180** and/or transmitter **182** to send information through a wireless link such as Bluetooth or cellular phone communication technology to a receiving and/or transmitting device **184** in communication with the microcomputer **64**. Alternatively, the biofeeder device **10** can be adapted to use radio Frequency (RFID) or Near Field Communication (NFC) technology. In this manner, the biofeeder device **10** can communicate with an independent devices located externally or may be designed to communicate to one or more units placed within the wastewater system. A pressure sensor **186** may be connected to tube **68** (connected to fluid bag **66**) to detect the weight of the solution as well as variations in pressure when the fluid is pumping. Using static pressure, the amount of fluid remaining in the bag can be detected and monitored. During dispense cycles, predetermined variations in pressure indicate that the pump **60** is working correctly. The pump **60** may include status indicators, green light **188** or red light **190**, to visually indicate the pump's working status. Low levels of fluid can be relayed to the microcomputer **64** and sent wirelesses to the remote unit **178**. The remote unit **178** is designed to be in communication with a main control computer **192** through wirelesses technology (main computer may have a transmitting/receiving device **194**) or hardwired through the use of a USB port **196** and cable **198**. The main control computer **192** maintains a database containing the locations of all the biofeeder devices **10** in a system, including its dispensing profiles as well as real time information. In this manner, all the biofeeder devices **10** can be monitored remotely so that when the fluid levels in the bags are depleted or there is a malfunction, individual units can be serviced.

The biofeeder device **10** is preferably powered using rechargeable batteries generating 12V to drive the pump **60**. The battery voltage is monitored by an A/D input on the microcomputer **64**. Battery level indicators are included to visually indicate if proper charge on the battery remains. Real time monitoring of the battery life can be kept through the use of a RTCIC. If the battery or the biological solution must be replaced, the user retrieves the removable module **14** or **16** from the base **20** by inserting a retrieving device **200**, illustrated herein as a hook, see FIG. **27**, within openings **128** of handle **126**, and lifting in an upward direction. The batteries or fluid is replaced and the modules **14** or **16** are lowered back into the correct, secured position onto the base **20**. In an alternative embodiment, the biofeeder **10** may contain one or more solar panels **202** which can be used to generate or be operatively connected to one or more components of the biofeeder device **10** to supply electricity to the device. As an illustrative example, the biofeeder device **10** would receive sunlight form one or more manholes within the wastewater system that are made of materials that allow sunlight to pass there through.

The present invention also contemplates the use of a plurality of biofeeder dispensing units within a wastewater treatment system to provide for a system for dispensing biological solutions into a wastewater system. Each of the biofeeder unit **10** may be in communication with one or more independently functioning biofeeder units within the system, as well as with one or more main computers which function to monitor and provide instructions for the entire system. By placing a plurality of biofeeder devices **10** within the system, a large area of the wastewater system can be controllably dispensed with one or more types of microbes or bacterial solutions. For example, one biofeeder device **10** may contain a bacterial solution having a single bacterial species. A second biofeeder device **10** within the system may have a bacterial solution with different species. For example, the system may include 5 biofeeder units **10** having Bacillus concentrations at high and low concentrations, 3 biofeeder units that dispense heavy grease bugs (HGB) to remove fats, oils, grease (FOG) concentration, and two biofeeder units **10** in specific locations dispensing different consortium of microbes for heavy load problems. Such system allows for delivery of microbes to different areas of the system based on residential, commercial, or industrial loading.

All patents and publications mentioned in this specification are indicative of the levels of those skilled in the art to which the invention pertains. All patents and publications are herein incorporated by reference to the same extent as if each individual publication was specifically and individually indicated to be incorporated by reference.

It is to be understood that while a certain form of the invention is illustrated, it is not to be limited to the specific form or arrangement herein described and shown. It will be apparent to those skilled in the art that various changes may be made without departing from the scope of the invention and the invention is not to be considered limited to what is shown and described in the specification and any drawings/figures included herein.

One skilled in the art will readily appreciate that the present invention is well adapted to carry out the objectives and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments, methods, procedures and techniques described herein are presently representative of the preferred embodiments, are intended to be exemplary and are not intended as limitations on the scope. Changes therein and other uses will occur to those skilled in the art which are encompassed within the spirit of the invention and are defined by the scope of the appended claims. Although the invention has been described in connection with specific preferred embodiments, it should be understood that the invention as claimed should not be unduly limited to such specific embodiments. Indeed, various modifications of the described modes for carrying out the invention which are obvious to those skilled in the art are intended to be within the scope of the following claims.

What is claimed is:

1. A device for dispensing biological solutions into a wastewater treatment system comprising:

a biological dispensing unit for placement within a wastewater environment; said biological dispensing unit containing a base having a surface for supporting at least one removable module and a vertical support structure extending upwardly from said base, said vertical support structure having a generally planar inner surface and a first receiving member sized and shaped to receive at

least a first portion of at least one removable module and to prevent lateral movement from said vertical support structure or said base, said base having at least one first securing member sized and shaped to couple with at least one second portion of said at least one removable module to prevent horizontal movement from said vertical support structure or said base;

said at least one removable module adapted to store a biological material therein and having at least one surface constructed and arranged to align with said vertical support structure inner surface, a second securing member sized and shaped to secure with said vertical support structure first receiving member, and a bottom surface having a second receiving member sized and shaped to receive said at least one first securing member positioned on said base; said at least one removable module being removeably coupled to said base unit and said vertical structure in a manner which prevents both lateral and vertical separation of said at least one removable module from said biological dispensing unit;

at least one biological material delivery unit comprising a pump operatively coupled to at least one dispensing tube adapted for dispensing at least a portion of said biological material stored within said at least one removable module to a wastewater treatment environment; and

a control unit adapted for operatively controlling said biological dispensing unit.

2. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said biological dispensing unit contains at least two removable modules.

3. The device for dispensing biological solutions into a wastewater treatment system according to claim **2** further including a power source, said power source being at least one battery stored within one of said at least two removable modules.

4. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** further including a power source.

5. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said at least one biological material delivery unit further comprises at least two dispensing tubes.

6. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said control unit is programmed to deliver a predetermined concentration of a biological sample at a pre-determined rate.

7. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said device for dispensing biological solutions into a wastewater treatment system is adapted to communicate to a independent device using wireless technology.

8. The device for dispensing biological solutions into a wastewater treatment system according to claim **7** wherein said wireless technology is Bluetooth technology.

9. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said biological material contains one or more microbes.

10. The device for dispensing biological solutions into a wastewater treatment system according to claim **9** wherein said biological material contains microbes from the same species.

11. The device for dispensing biological solutions into a wastewater treatment system according to claim **9** wherein said biological material contains microbes from the at least two different species.

12. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said biological dispensing unit is programmed to dispense said biological materials based on one or more factors.

13. The device for dispensing biological solutions into a wastewater treatment system according to claim **12** wherein said biological dispensing unit is programmed to dispense said biological materials based on diurnal cycles.

14. The device for dispensing biological solutions into a wastewater treatment system according to claim **12** wherein said biological dispensing unit is programmed to dispense said biological materials based on seasonal changes.

15. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said biological dispensing unit contains at least one solar panel.

16. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** wherein said at least one removable module adapted to store a biological material therein contains a gripping structure.

17. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** further adapted to secure to a portion of the environment of said wastewater.

18. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** further including spring loaded bracket for removeably attaching to two spaced apart ladder rungs, said spring loaded bracket having a first fixed end configured to secure to a portion of said first ladder rung and a second movable end configured to secure to said second ladder rung.

19. The device for dispensing biological solutions into a wastewater treatment system according to claim **1** further including a securing device for securing said device to a surface of a manhole, said securing device having:

at least one elongated member having a first end and an opposing second end;

a first extender member slidably engaged to said at least one elongated member and having an overhang portion positioned at one end, said overhang configured to rest on said surface of said manhole; and

a second extender member slidably engaged to said at least one elongated member and having an overhang portion positioned at one end, said overhang configured to rest on said surface of said manhole.

20. The device for dispensing biological solutions into a wastewater treatment system according to claim **19** wherein said securing device includes two intersecting elongated members forming a cross-like configuration.

21. A system for dispensing biological solutions into a wastewater treatment system comprising:

a plurality of biological dispensing units for placement within a wastewater environment; each said biological dispensing unit containing a base and a vertical support structure extending upwardly from said base, said vertical support structure having a generally planar inner surface and a first receiving member sized and shaped to receive at least a first portion of at least one removable module and to prevent lateral movement from said vertical support structure or said base, said base having at least one first securing member sized and shaped to couple with at least one second portion of said at least one removable module to prevent horizontal movement from said vertical support structure or said base; at least one removable module adapted to store a biological material therein and having at least one surface constructed and arranged to align with said vertical support

structure inner surface, a second securing member sized and shaped to secure with said vertical support structure first receiving member, and a bottom surface having a second receiving member sized and shaped to receive said at least one first securing member positioned on said base, said at least one removable module being removeably coupled to said base unit and said vertical structure in a manner which prevents both lateral and vertical separation of said at least one removable module from said biological dispensing unit; at least one biological material delivery unit adapted for dispensing at least a portion of said biological material stored within said at least one removable modules; and a main control unit adapted for operatively controlling said biological dispensing unit;

whereby said plurality of biological dispensing units are placed within said wastewater environment at predetermined locations.

22. The system for dispensing biological solutions into a wastewater treatment system according to claim **21** wherein said system comprises at least two biological dispensing units, each said dispensing unit positioned at a predetermined space within said wastewater treatment system.

23. The system for dispensing biological solutions into a wastewater treatment system according to claim **22** wherein each said biological dispensing unit is wirelessly connected to at least one other said biological dispensing unit.

24. The system for dispensing biological solutions into a wastewater treatment system according to claim **23** wherein each said biological dispensing unit contains differing biological materials.

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